NEW EVIDENCE FOR SILICON AS THE MAJOR LIGHT ELEMENT IN THE EARTH'S CORE.
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The attached Figure 1 is a new version of a figure which has been published for the first time in the paper by Jagoutz et al. [1] for primitive rocks from the Earth's mantle. The extension to a variety of terrestrial basalts as well as to SNC (S = Shergottites; N = Nakhlites; C = Chassigny) -meteorites was included in the paper by Wänke et al. [2]. Fig. 1 contains new data from Mars both in form of new analyzed SNC-meteorites as well as the data points of the Viking soil. For example in 1988 a second shergottite-lherzolite, LEW 88516, was recovered being mineralogically very similar to ALHA77005 [3]. However its Sc/Yb ratio of 47.4 indicates a higher degree of fractionation compared to ALHA77005 with Sc/Yb = 40.6, which is to be considered as the more primitive one. Undifferentiated terrestrial mantle rock samples should have a chondritic Sc/Yb ratio of 35.8 [4]. It is possible to draw a number of far-reaching conclusions from the figure:

1. The fact that the Viking data point fits nicely to the Mars fractionation line as determined by the SNC-meteorites is a new and additional proof that the SNC's represent Martian surface rocks ejected from Mars and delivered to Earth by huge impacts.

2. The fact that compared to the Mars fractionation line the terrestrial fractionation line is shifted to higher Mg/Si ratios as well as to higher Al/Si ratios points towards a depletion of Si in the Earth's mantle relative to the Martian mantle.

A depletion of Si relative to CI-chondrites in the Earth's mantle was recognized in the past by various authors. The CI-chondrites formed at solar distances of about 2.5 AU or more are not the best representatives of the matter from which the Earth and Mars was formed as it can be argued that in the solar nebula the radial fractionation of chemical elements occurred. In addition, it might and has been argued that CI-chondrites as all other primitive meteorites did not grow to planet size. Hence, the comparison to the Earth's close neighbour Mars (solar distance 1.52 AU compared to 1.00 AU for the Earth) has a much stronger bearing. The most straightforward explanation for the depletion of Si in the Earth's mantle is the assumption that part of the Si of the bulk Earth entered the Earth's core in metallic form. Beside Si also V, Cr and Mn are depleted in the Earth's mantle, whereas the Martian mantle shows no depletion of these elements as illustrated for chromium in fig. 2. Under solar-nebula conditions Mn is more volatile than Si and volatility could be partly responsible for the observed depletion. However, in the case of Cr and the refractory element V, the most plausible explanation

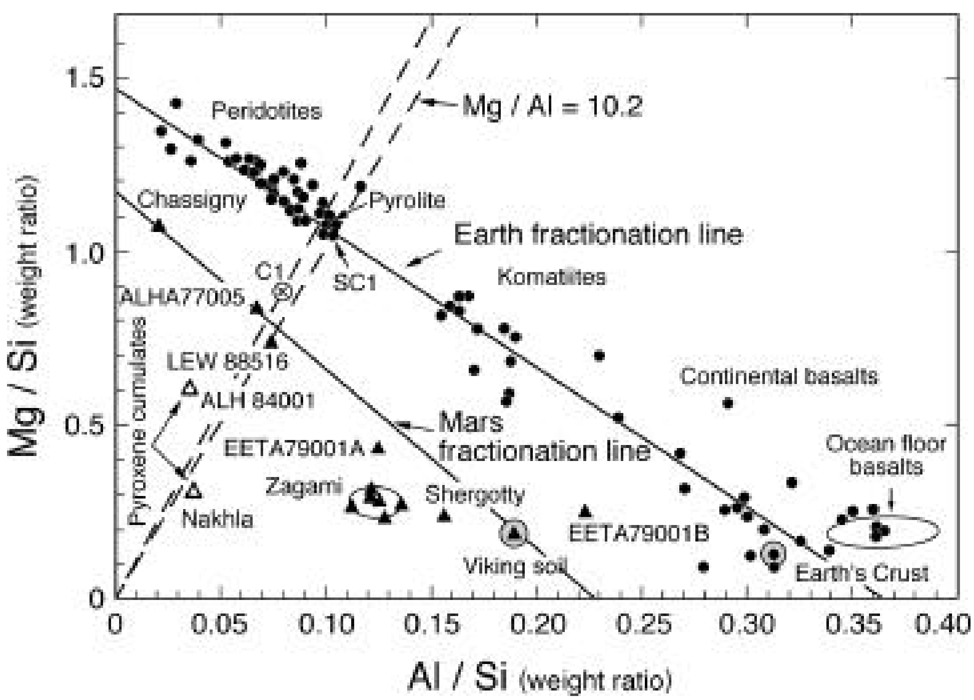

Fig. 1

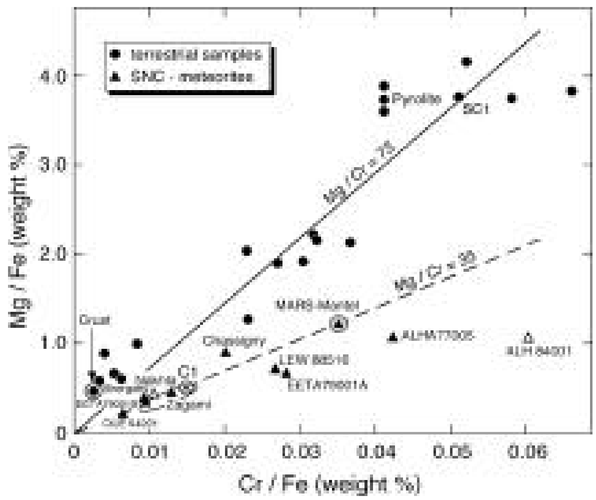

Fig. 2

for their depletion is their removal into the core in metallic form.

In 1981 Wänke has shown that it is possible to build the Earth of strictly CI elemental abundances if one puts 12.5 % Si into the core [5]. Metallic Si in the Earth's core in order to reduce both melting point and density was proposed by Ringwood [6, 7] and MacDonald and Knopoff [8]. An Earth's model with 7.3 % Si in the Earth's core was recently published by Allègre et al [9]. Later on Ringwood [10] abandoned this model and proposed O as the light element in the core. Recent experiments by Boehler [11] made the presence of oxygen in the Earth's core unlikely.

In our new model we assume identical Mg/Al ratios for Earth and Mars. Fig. 3 shows in detail the part of the intersections of the terrestrial and Martian fractionation lines with two different Mg/Al ratio lines: one line with a CI Mg/Al ratio of 11.1 and the other

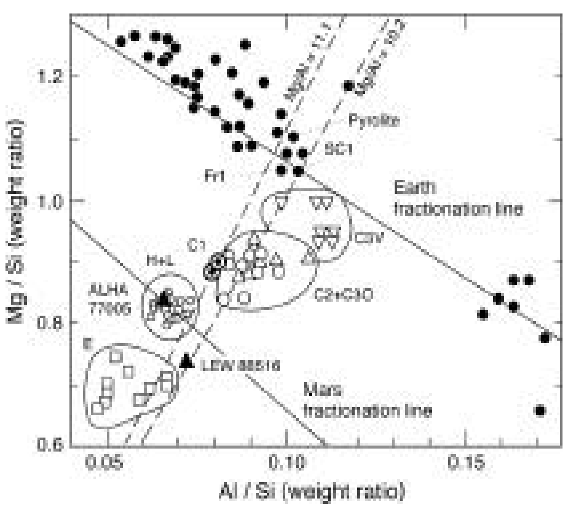

Fig. 3

with a Mg/Al ratio of the most primitive lherzolite nodule SC1 from the Earth's mantle. Independently which Mg/Al ratio was proposed for the building blocks for Earth and Mars, the ratios for $Mg/Si_{(Earth)}$ to $Mg/Si_{(Mars)}$ are identical. The depletion factor of 1.33 between $Mg/Si_{(E)}$ and $Mg/Si_{(M)}$ corresponds to 14.4 % Si in the Earth's core and the depletion factor of 2.09 between $Mg/Cr_{(E)}$ and $Mg/Cr_{(M)}$ yields a Cr content of 0.7 % for the core. Assuming CI ratios of Fe/Mg, Fe/Ni, Ni/Co, Fe/Mn, and Mg/Cr for the whole Earth, we obtain a composition of the Earth's core as shown in the Table together with the data for Mars. Contrary to the Earth, Mars has a Fe-FeS-core which is responsible for the striking depletion of all elements with chalcophile character in the Martian mantle. The concentration of the moderately volatile element sulfur in the Earth's mantle is substantially lower than those of other elements with similar volatility, for example Zn. This depletion can also be explained by the extraction of 1.5 % S into the core.

Table: Core composition

Element	Earth	Mars
Fe %	77.6	78.1
Ni	4.8	7.8
Co	0.25	0.38
S	1.5	13.7
Si	14.4	
Cr	0.7	
Mn	0.68	
core mass %	32.8	21.0

We are of course aware of the fact that using available thermodynamic data it is difficult to explain a Si concentration of 14.4 % in the FeNi phase under conditions of classical models for the primitive solar nebula [12]. On the other hand, the observation outlined above provide highly conclusive evidence for a Si concentration in the Earth's core in the range above 12 wt %.

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